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6111 7590 01/16/2004 GENERAL ELECTRIC COMPANY ANDREW C HESS GE AIRCRAFT ENGINES ONE NEUMANN WAY M/D H17 CINCINNATI, OH 452156301			EXAMINER CLEVELAND, MICHAEL B	
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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Paper No. 011004

Application Number: 09/670,189
Filing Date: September 26, 2000
Appellant(s): WHEAT ET AL.

K. Scott O'Brian
For Appellant

MAILED

JAN 15 2004

EXAMINER'S ANSWER

GROUP 1700

This is in response to the appeal brief filed 10/23/2003.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) *Related Appeals and Interferences*

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) *Status of Claims*

The statement of the status of the claims contained in the brief is correct.

(4) *Status of Amendments After Final*

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) *Summary of Invention*

The summary of invention contained in the brief is correct.

(6) *Issues*

The appellant's statement of the issues in the brief is correct.

(7) *Grouping of Claims*

The appellant's statement of the issues in the brief is correct.

The rejection of claims 1-2 stand or fall together under issue 1 because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7). Claims 4, 5, 6, 7, 8, 9, 10, and 11 each stand separately under Issue 1 because Appellant's brief includes a statement that they do not stand or fall together under Issue 1 and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

The rejection of claims 12-13 stand or fall together under issue 2 because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7). Claims 3, 14, 15, 16, 17, 18, 19 and 20 each stand separately under Issue 2 because Appellant's brief includes a statement that they do not stand or fall together under Issue 2 and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

The rejection of claims 1, 3, 5, 6, 9, and 11 stand or fall together under issue 3 because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. Claims 12, 15, 17, and 20 stand or fall together under

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issue 3 because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. Claims 7 and 18 each stand separately under Issue 3 because Appellant's brief includes a statement that they do not stand or fall together under Issue 3 and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

5,989,733	WARNES et al.	11-1999
5,261,963	BASTA et al.	11-1993
4,180,400	SMITH et al.	12-1979
5,658,614	BASTA et al.	8-1997
3,951,642	CHANG et al.	4-1976
4,066,806	SPEIRS et al.	1-1978
4,142,023	BORNSTEIN et al.	2-1979

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Issue 1 Claims 1-2 and 4-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Warnes '733 in view of Basta '963 and Smith '400.

Claim 1 is representative of the claims and requires

A method for coating an article, comprising the steps of

providing the article having a surface;

preparing a coating source comprising:

a solid aluminum halide,

a solid fluoride or a solid iodide of a modifying element as a source of the modifying element, the modifying element being selected from the group consisting of zirconium, hafnium, and yttrium, and combinations thereof, and

a carrier gas,

producing a coating gas from the coating source, the coating gas comprising a gaseous aluminum halide, a gaseous fluoride or a gaseous iodide of the modifying element, and the carrier gas; and

contacting the coating gas to the article; and simultaneously

heating the coating gas and the article to a coating temperature of at least about 1850 °F for a period of time sufficient to permit aluminum and the modifying element to coat onto the surface of the article.

Claims 1-2 (Applicant has stated that claim 2 stands or falls with claim 1, therefore only claim 1 is discussed):

Warnes '733 teaches a chemical vapor deposition (CVD) method for coating an article, comprising:

providing an article with a surface (col. 5, lines 46-67);

preparing a coating source comprising argon (i.e., a carrier gas (col. 6, lines 9-10));

producing a coating gas (col. 6, lines 5-37) which comprises aluminum trichloride (i.e., an aluminum halide) (col. 6, lines 6-9), hafnium tetrachloride (i.e., a chloride of a modifying element) (col. 6, line 10), zirconium tetrachloride (i.e., a chloride of a modifying element) (col. 6, lines 10), and argon (i.e., a carrier gas (col. 6, lines 9-10));

contacting the coating source to the article (col. 6, lines 32-34); and

heating the coating source and the article to a coating temperature of 1080 °C (1976 °F) (col. 6, lines 5-6) for a period of time to permit aluminum and the modifying element(s) to coat onto the surface of the article (col. 6, lines 32-34).

Warnes '733 does not explicitly teach preparing a coating source that comprises a solid aluminum halide and a solid fluoride or iodide of zirconium, hafnium, and/or yttrium. Instead, Warnes '733 teaches providing the metal chloride CVD precursors by flowing HCl over/through samples of the metals (col. 6, lines 12-32). However, another method to provide metal halide reaction precursors that is notoriously well known in the art of CVD is evaporation of the solid precursor. Smith '400 is cited to demonstrate this notoriously well known method of providing metal halide reaction precursors, such as aluminum chloride, hafnium halides, and zirconium

halides (col. 5, lines 15-28). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have provided the metal halide precursors of Warnes '733 by physical evaporation instead of by reaction of metal with HCl with a reasonable expectation of success and with the expectation of similar results because Smith '400 teaches that evaporation of the solid material is a suitable method of providing gaseous metal halide precursors.

Warnes '733 does not explicitly teach the use of a fluoride or iodide of the modifying element (hafnium or zirconium). Smith '400 teaches the use of other halides as equivalent CVD precursors (col. 5, lines 26-28), but does not explicitly teach fluoride or iodides. However, fluorides are notoriously well known in the art of CVD as suitable metal halide precursors. Basta '963 (which is referenced in Warnes '733, col. 5, lines 46-53 and which, like Warnes '733, is directed to the formation of aluminide coatings on nickel base superalloy substrates (col. 7, lines 35-57)) is cited to demonstrate this notoriously well known species of metal halide precursors. Basta '963 explicitly discloses the suitability of aluminum chloride and aluminum fluoride as metal halide precursors for CVD (See, e.g., col. 4, lines 21-49), but also discusses hafnium and zirconium halides (col. 9, lines 26-29). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used hafnium or zirconium fluoride instead of the hafnium or zirconium chlorides of Warnes '733 with the expectation of similar results and with a reasonable expectation of success because Smith '400 and Basta '963 demonstrates that metal fluorides are recognized in the art of CVD as suitable metal halide precursors.

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Claim 4

Claim 4 requires the features of claim 1 and further requires that the aluminum halide is aluminum trifluoride.

Warnes '733, Smith '400, and Basta '963 teach the features of claim 1, as discussed above. Warnes '733 uses aluminum trichloride (col. 5, lines 15-20) as a precursor to provide aluminide coatings for nickel base superalloy substrates (col. 2, lines 27-35). Basta '963 (which is referenced by primary reference Warnes '733, col. 5, lines 46-53) teaches that aluminum trifluoride is a suitable precursor for providing aluminide coatings to nickel base superalloy substrates (col. 7, lines 35-57). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the aluminum trifluoride of Basta '963 instead of the aluminum trichloride of Warnes '733 with the expectation of similar results and with a reasonable expectation of success because Basta '963 demonstrates that aluminum trifluoride is recognized in the art of CVD as suitable a suitable precursor for providing aluminide coatings to nickel base superalloy substrates.

Claim 5

Claim 5 requires the features of claim 1 and further requires that the fluoride of the modifying element is a tetrafluoride.

Warnes '733, Smith '400, and Basta '963 render the use of hafnium or zirconium fluoride obvious for the reasons discussed above regarding claim 1. Hafnium and zirconium have oxidation numbers of +4. Fluorine (like all halogens) has an oxidation number of -1. Therefore, the chemical formula of general formula of hafnium halides is HfX_4 (hafnium tetrahalide), and the formula of hafnium fluoride is HfF_4 (hafnium tetrafluoride). Compare Warnes '733, col. 6, lines 10-29.

Claim 6

Claim 6 requires the features of claim 1 and further requires that the coating source include elemental solid aluminum.

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Warnes '733, Smith '400, and Basta '963 teach the features of claim 1, as discussed above. Warnes '733 teaches providing aluminum chloride precursors by flowing HCl over the elemental aluminum (col. 5, lines 15-29). Smith '400 teaches that metal halide CVD precursors, such as aluminum chloride, may be provided by evaporation from a solid source or by reacting solid metal with hydrogen chloride (col. 5, lines 13-28). Thus, it teaches the equivalence of evaporation and reacting solid metal with hydrogen. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined the prior art methods of physical evaporation of metal halide and reaction of solid metal with HCl (or HF: See Basta '963, col. 4, lines 21-48; col. 9, lines 19-32) with a reasonable expectation of success and with the expectation of similar results because the combination of equivalents has been held to be a *prima facie* case of obviousness. See MPEP 2144.06. The coating source would then include both the solid metal halides and the solid elemental metal which reacts with the HCl.

Claim 7

Claim 7 requires the features of claim 1 and further requires that the coating source include elemental solid modifying element

Warnes '733, Smith '400, and Basta '963 teach the features of claim 1, as discussed above. Warnes '733 teaches providing hafnium and zirconium chloride precursors by flowing HCl over the elemental metals (col. 5, lines 15-29). Smith '400 teaches that metal halide CVD precursors, such as hafnium and zirconium halides, may be provided by evaporation from a solid source or by reacting solid metal with hydrogen halides (col. 5, lines 13-28), such as HCl or HF (See Basta '963, col. 4, lines 21-48, col. 9, lines 19-32). Thus, Smith '400 teaches the equivalence of evaporation and reacting solid metal with hydrogen. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined the prior art methods of physical evaporation of metal halide and reaction of solid metal with HCl (or HF: See Basta '963, col. 4, lines 21-48, col. 9, lines 19-32) with a reasonable expectation of success and with the expectation of similar results because the combination of equivalents has been held to be a *prima facie* case of obviousness. See MPEP 2144.06. The coating source would then include both the solid metal halides and the solid elemental metal which reacts with the HCl.

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Claim 8

Claim 8 requires the features of claim 1 and further requires the step of providing the solid fluoride or the solid iodide of the modifying element separated from the article surface.

Warnes '733, Smith '400, and Basta '963 render the use of hafnium or zirconium fluoride precursors via the evaporation of the solid metal halides obvious, as discussed above regarding claim 1. Warnes '733 teaches providing hafnium and zirconium chloride precursors by flowing HCl over the elemental metals (col. 5, lines 15-29) using the apparatus of Basta '963 (col. 6, lines 49-50). Basta '963 teaches that the gases are generated in generators (20, 22) and passed to reactor (13) (col. 4, lines 21-48). Likewise, Smith '400 teaches that the precursors are generated (col. 5, lines 14-28) and then passed to a reactor (col. 5, lines 28-30). Each reference suggests that the gaseous precursors are produced in a separate location from the CVD reaction chamber (where the object to be coated is located), and therefore they teach that the solid precursors are separated from the article surface.

Claim 9

Claim 9 requires the features of claim 1 and further requires the step of providing the fluoride or the iodide of the modifying element applied directly to the article surface.

Warnes '733, Smith '400, and Basta '963 render the use of hafnium or zirconium fluoride precursors obvious, as discussed above regarding claim 1. Warnes '733 teaches that the precursors, including the hafnium and/or zirconium precursors react at the substrate surface (col. 6, lines 23-38). Therefore, the hafnium and/or zirconium fluoride must directly contact the surface.

Claim 10

Claim 10 requires the features of claim 1 and further specifies that the modifying element is hafnium.

Warnes '733, Smith '400, and Basta '963 render the use of hafnium or zirconium fluoride precursors obvious, as discussed above regarding claim 1. Warnes '733 teaches that the modifying element may be hafnium (col. 6, lines 9-11, 32-34).

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Claim 11

Claim 11 requires the features of claim 1 and further specifies that the modifying element is zirconium.

Warnes '733, Smith '400, and Basta '963 render the use of hafnium or zirconium fluoride precursors obvious, as discussed above regarding claim 1. Warnes '733 teaches that the modifying element may be zirconium (col. 6, lines 9-11, 32-34).

Issue 2 Claims 3 and 12-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Warnes '733 in view of Basta '963 and Smith '400, as applied to claim 1, and further in view of Basta '614.

Claim 3

Claim 3 requires the features of claim 1 and further specifies that the article is an airfoil made of a nickel-base superalloy.

Warnes '733, Smith '400, and Basta '963 teach the application of platinum aluminide coatings by the method of claim 1, as described above. The coatings are applied to nickel-base superalloys (Warnes '733, col. 3, lines 43-47) and are of interest in the application to turbine blades (Warnes '733, col. 1, lines 59-67). Warnes '733, Smith '400, and Basta '963 do not explicitly teach that the substrate is an airfoil.

Basta '614 (which is specifically mentioned in Warnes '733, col. 2, lines 14-19) teaches that airfoils benefit from CVD applied platinum aluminide coatings (col. 3, lines 25-37). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the method of Warnes '733, Smith '400, and Basta '963 on an airfoil as the particular turbine engine component to receive the coating because Basta '614 teaches that airfoils benefit from such coatings.

Claims 12-13 (Applicant has stated that claim 13 stands or falls with claim 12; therefore only claim 12 is discussed).

Claim 12 is independent. Claim 12 is identical to claim 1, except for the following three features.

- 1) it specifies that the substrate is an airfoil,

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2) it specifies that the modifying element halide is hafnium fluoride or zirconium fluoride, and

3) it limits the heating range to 1850-2000 °F.

Warnes '733, Smith '400, and Basta '963 teach the application of platinum aluminide coatings using hafnium or zirconium fluoride precursors by the method of claim 1, as described above. Warnes '733 teaches a heating temperature of 1080 °C (1976 °F) (col 6, lines 5-6). Basta '614 renders the application of the method of Warnes '733, Smith '400, and Basta '963 to an airfoil for the reasons given above regarding claim 3.

Claim 14

Claim 14 requires the features of claim 12 and further requires that the fluoride of the modifying element is zirconium tetrafluoride.

Warnes '733, Smith '400, Basta '963, and Basta '614 render the use of zirconium fluoride obvious for the reasons discussed above regarding claim 12. The formula of zirconium fluoride is ZrF_4 (zirconium tetrafluoride), as discussed above regarding claim 5.

Claim 15

Claim 15 requires the features of claim 12 and further requires that the fluoride of the modifying element is hafnium tetrafluoride.

Warnes '733, Smith '400, Basta '963, and Basta '614 render the use of hafnium fluoride obvious for the reasons discussed above regarding claim 12. The formula of hafnium fluoride is HfF_4 (hafnium tetrafluoride), as discussed above regarding claim 5.

Claim 16

Claim 16 requires the features of claim 12 and further requires that the aluminum halide is aluminum trifluoride, the fluoride of the modifying element is zirconium tetrafluoride, and a weight ratio of aluminum trifluoride to zirconium tetrafluoride is from about 1.4:1 to about 3:1.

Warnes '733, Smith '400, Basta '963, and Basta '614 render the use of zirconium tetrafluoride obvious for the reasons discussed above regarding claims 12 and 14. They also render the use of aluminum trifluoride obvious for the reasons discussed above regarding claim 4. The references does not explicitly teach a ratio of AlF_3 to ZrF_4 of between 1.4 and 3 (which

corresponds to a molar ratio of Al to Zr of 2.7-6). However, it is the Examiner's position that the range of the molar ratio of Al to Zr overlaps that effectively claimed by Applicant, as described in greater detail as follows:

The Example of Warnes '733, col. 6, lines 5-37 provides Hf as the major modifying element. It is clear that this amount of Hf satisfies the desired weight ratio of the abstract (0.01-8 wt. %). It is also clear from the abstract Zr may be supplied in the same weight amount of 0.01-8 wt%. However, because Hf (MW=178.5) has a molecular weight approximately twice that of Zr (MW=91.2), approximately twice as many moles will be necessary to provide the same weight. In the Example of '733, col. 6, lines 5-37, the molar ratio approximately corresponds to the volumetric ratio of the gases (assuming the gases behave as ideal gases). The flow is 4% of a mixture that is >90% aluminum trichloride (i.e., about 3.6 vol. % and therefore about 3.6 mol % AlCl_3) and about 1.5 vol % (and therefore mol %) HfCl_4 . As stated above, it would take approximately twice as many moles of ZrCl_4 (or ZrF_4) to produce the same weight of Zr as Hf in the coating. Thus, 3.0 vol. % ZrCl_4 or ZrF_4 would have been necessary to produce the same weight. Therefore, the molar ratio of Al/Zr for this embodiment is approximately $3.6/3.0=1.2$.

The literal teaching of col. 6, lines 5-37 suggests a much higher ratio (3.6 vol. % AlCl_3 /(1% (col. 6, lines 28-32) of the 1.5 vol. % $\text{HfCl}_4/\text{ZrCl}_4$ mixture)= $3.6/0.015=240$). Therefore, it is the Examiner's position that Warnes '733 fairly suggests molar ratios of Al/Zr covering at least the range 1.2 to 240. The subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to have selected the overlapping portion of the range disclosed by the reference because overlapping ranges have been held to be a *prima facie* case of obviousness, see *In re Malagari*, 182 U.S.P.Q. 549.

Claim 17

Claim 17 requires the features of claim 12 and further requires that the coating source include elemental solid aluminum. Warnes '733, Smith '400, Basta '963, and Basta '614 teach the features of claim 12, as discussed above. The references fairly teach the use of solid elemental aluminum as part of the coating source for the reasons already described regarding claim 6.

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Claim 18

Claim 18 requires the features of claim 12 and further requires that the coating source include elemental solid modifying element.

Warnes '733, Smith '400, Basta '963, and Basta '614 teach the features of claim 12, as discussed above. The references fairly teach the use of solid elemental hafnium or zirconium as part of the coating source for the reasons already described regarding claim 7.

Claim 19

Claim 19 requires the features of claim 12 and further requires the step of providing the solid fluoride of the modifying element separated from the airfoil surface.

Warnes '733, Smith '400, Basta '963, and Basta '614 render the use of hafnium or zirconium fluoride precursors via the evaporation of the solid metal halides obvious, as discussed above regarding claim 12. The references teach that the solid source of the gaseous precursor are separate from the reaction chamber in which the article to be coated (e.g., the airfoil of Basta '614) is located, as described above regarding claim 8.

Claim 20

Claim 20 requires the features of claim 12 and further requires the step of providing the fluoride of the modifying element applied directly to the airfoil surface.

Warnes '733, Smith '400, Basta '963, and Basta '614 render the use of hafnium or zirconium fluoride precursors via the evaporation of the solid metal halides obvious, as discussed above regarding claim 12. Warnes '733 teaches that the precursors contact the surface, as described above regarding claim 9.

Issue 3 Claims 1, 3, 5-7, 9, 11-12, 15, 17-18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang '642 in view of Speirs '806 and Bornstein '023.

Claims 1, 3, 5, 6, 9, and 11 (Applicant has stated that claims 3, 5, 6, 9, and 11 stand or fall with claim 1, therefore only claim 1 is discussed):

Claim 1 is recited above under **Issue 1**.

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Chang '642 teaches a pack diffusion method of coating article, comprising the steps of providing the article having a surface (col. 3, line 63-col. 5, line 10),

preparing a coating source containing

solid aluminum,

solid ammonium fluoride,

solid hafnium tetrafluoride

and hydrogen (a carrier gas) (col. 4, lines 1-41)

contacting the coating source to the article surface by embedding the article in the coating source (col. 4, lines 38-40); and

heating the article to a coating temperature of 1900-1950 °F for a period of time sufficient to permit aluminum and the modifying element to coat onto the surface of the article (col. 4, lines 38-68).

Chang '642 does not explicitly teach that 1) the coating source includes an aluminum halide or a carrier gas nor 2) producing a coating gas from the coating source and contacting it to the article.

Chang '642 teaches the inclusion of ammonium fluoride (e.g., col. 4, lines 8), a commonly known energizer in the powder pack. However, Speirs '806 teaches that energizers comprising aluminum chloride are also known as energizers in aluminum pack diffusion processes (col. 3, lines 47-63). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have included aluminum halide with the energizer in the aluminum pack diffusion process of Chang '642 with a reasonable expectation of success and with the expectation of similar results because Speirs '806 teaches that energizers comprising aluminum chloride are also known as energizers in aluminum pack diffusion processes.

Chang '642 and Speirs '806 do not explicitly teach that the coating source vaporizes to form gaseous aluminum halide and gaseous hafnium fluoride. However, the current application (p. 8 and claim 8) reveals that the temperatures of Chang '642 are above the vaporization

temperature of the hafnium and aluminum halides. Therefore, the hafnium and aluminum halides would necessarily have vaporized and formed part of a coating gas during the process.

(The Examiner notes that Bornstein '023 was originally cited to demonstrate air or inert gas as suitable atmospheres (and thus, carrier gases) for aluminum pack diffusion processes (col. 1, lines 39-46). However, in the After Final response filed 8/25/2003, p. 13, Applicant correctly noted that Chang '642 teaches an atmosphere of hydrogen. Therefore, Chang '642 teaches a carrier gas, and the citation of Bornstein '023 is extraneous to the rejection.)

Claim 7

Claim 7 requires the features of claim 1 and further requires that the coating source include elemental solid modifying element.

Chang '642, Speirs '806, and Bornstein '023 teach the method of claim 1, as described above. Chang teaches that the source of hafnium may be solid Hf powder or HfF₄ (col. 4, lines 33-37). It is well settled that "[i]t is *prima facie* obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition used for the very same purpose. . . [T]he idea of combining them flows logically from their having been individually taught in the prior art." *In re Kerkhoven*, 626 F.2d 846, 850, 205 USPQ 1069, 1072 (CCPA 1980). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined solid Hf powder and HfF₄ as the hafnium source of Chang '642 because Chang '642 teaches that each is useful as the hafnium source.

Claims 12, 15, 17, and 20 (Applicant has stated that claims 15, 17, and 20 stand or fall with claim 12, therefore only claim 12 is discussed).

Claim 12 is independent. Claim 12 is identical to claim 1, except for the following three features:

- 1) it specifies that the substrate is an airfoil,
- 2) it specifies that the modifying element halide is hafnium fluoride or zirconium fluoride; and
- 3) it limits the heating range to 1850-2000 °F.

Chang '642, Speirs '806, and Bornstein '023 teach the method of claim 1, including the use of hafnium fluoride (Chang '642, col. 4, lines 33-37) and heating the article to a coating temperature of 1900-1950 °F (Chang '642, col. 4, lines 38-41), as described above. Aluminum pack diffusion coatings may be used for airfoils (Speirs '806, col. 2, lines 55-68).

Claim 18

Claim 18 requires the features of claim 12 and further requires that the coating source include elemental solid modifying element.

Chang '642, Speirs '806, and Bornstein '023 teach the method of claim 12, as described above, and teach the inclusion of Hf powder as described regarding claim 7 above.

(11) Response to Argument

Issue 1

Claims 1-2

(Response to p. 4, 2nd paragraph) Applicant argues that Warnes '733 does not teach that the aluminum trichloride, zirconium trichloride [sic], and hafnium tetrachloride gas are in solid form. The argument is unconvincing because it does not address the teachings of Smith '400 that physical evaporation is a method of providing metal halide precursors. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). The examiner notes that zirconium chloride is a tetrachloride, not a trichloride ('733, col. 6, lines 10 and 27).

(Response to p. 4, 3rd paragraph) Applicant argues that Basta '963 is mischaracterized as teaching mentioning hafnium or zirconium fluoride because it only teaches "hafnium halides" and zirconium halides". First of all, it is the Examiner's position that the teachings of "hafnium halides" and "zirconium halides" is by itself sufficient to suggest fluorides to one of ordinary skill in the art because the set of hafnium halides consists of exactly five members: hafnium fluoride, hafnium chloride, hafnium bromide, hafnium iodide, and hafnium astatide. Basta is cited primarily fluorides are notoriously well known in the art of CVD as suitable metal halide precursors. The Examiner chose Basta '963 as the particular reference to demonstrate this well

known fact because it is cited by the primary reference Warnes '733 (at col. 6, lines 48-50), it explicitly demonstrates that aluminum fluoride is a suitable precursor for forming aluminide coating of nickel-base superalloy substrates (col. 7, lines 35-57), and fairly indicates that the same teachings are relevant to hafnium and zirconium (col. 9, lines 25-30), the very same elements of interest both to Warnes '733 and to Applicant. The Examiner further notes that in the CVD reaction of Warnes '733 and the metal halide precursors react with hydrogen to form the metal that diffuses into the substrate and an acid halide by-product ('733, col. 6, lines 34-37). That is, the halide does not form part of the coating. Accordingly, one of ordinary skill in the art would have concluded that hafnium fluoride would have been a suitable hafnium halide because fluoride is one of only five halide species, because Basta '963 explicitly teaches that fluoride is a halide, and because the teachings of Warnes '733 makes it clear that the particular halogen escapes in a by-product of the reaction.

(Response to paragraph bridging pp. 4-5) Applicant argues that the present specification states unequivocally that "the chlorides and bromides of the modifying element are not within the scope of the present invention, as they are not thermodynamically and kinetically suitable." The argument is unconvincing because the statement (at p. 4, lines 8-10 of the specification) is unsupported by a showing of evidence. The only showing regarding the suitability of chlorides and bromides of hafnium or zirconium is the unequivocal teaching of Warnes '733 that hafnium and zirconium chlorides *are* suitable to deposit hafnium and zirconium into an aluminide coating. Thus, Applicant's statement at p. 4, lines 8-10 is contradicted by the evidence of record, but is not supported by any evidence.

(Response to p. 5, 1st full paragraph) Applicant argues that Smith is directed to an approach for depositing kappa aluminum oxide. Insofar as this is an argument that Smith '400 is nonanalogous art, it has been held that a prior art reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the applicant was concerned, in order to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, Smith '400 is reasonably pertinent to the particular problem with which applicant was concerned, specifically the provision of metal halide precursors for CVD processes. The selection of something based on its known suitability for its intended use has been held to support a *prima*

facie case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. Smith '400 is cited merely to demonstrate the notoriously well known method of providing metal halides by evaporating them from solid or liquid form. The Examiner chose Smith '400 as the particular reference to demonstrate this well known fact because it teaches the equivalence of evaporation and reaction of metal with acid halide (the method used by Warnes '733 to provide its precursor) and fairly indicates that the same teachings are relevant to hafnium and zirconium (col. 5, lines 15-28), the very same elements of interest both to Warnes '733 and to Applicant. The Examiner acknowledges that Smith '400 does not use the metal halides in the same reaction as that of Warnes '733, but such would not have disguised the teachings of method of providing metal halide precursors for which it is cited.

(Response to p. 5, 2nd full paragraph to p. 6, 2nd full paragraph) Applicant argues that there is no teaching in any of the references of "a coating source comprising a solid aluminum halide, a solid fluoride or a solid iodide of a modifying element, and a carrier gas." Applicant argues that Warnes only teaches that the aluminum, hafnium, and zirconium chlorides are present only as gases. The argument is unconvincing because it does not address the level of skill in the art reflected by Smith '400 and Basta '963.

Applicant argues that "there is no reason to substitute the approach of Smith for that taught by Warnes." The argument is incorrect. It is well settled that the selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. Smith '400 demonstrates the suitability of evaporation of a solid metal halide as a method of forming a gaseous metal halide precursor for use in CVD reactions.

Applicant argues that Basta '963 teaches aluminum trifluoride and "hafnium halides" and "zirconium halides", but has not teaching of hafnium fluoride, zirconium fluoride, hafnium iodide, or zirconium iodide. The argument is unconvincing because there are only 5 halogens (Group VII A of the Periodic Table) and that Basta '963 specifically identifies fluorides as a halide.

(Response to paragraph bridging pp 5-6) Applicant argues that the distinction between whether the modifying element is initially provided in the coating source in a solid or a gaseous

form is an important one because the use of a gaseous coating source requires special apparatus to generate the gas, which is then supplied to the coating apparatus. The argument is unconvincing because the teachings of Smith '400 indicate that the technology to generate such gas is sufficiently well understood. Furthermore, the claims do not exclude the use of special apparatus. Still further, the claims expressly require the conversion of the solid precursor to a gas, and therefore it appears that Applicant must also require apparatus to achieve the conversion.

Applicant argues that "when a solid aluminum halide and a solid source of the modifying element are used, the solids may be placed directly into the coating apparatus or placed directly in contact with the surface to be coated." The argument is unconvincing because no claim presently requires placing the solids directly into the coating apparatus or directly into contact with the surface to be coated.

Claim 4

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Applicant's arguments regarding Warnes individually are unconvincing because they do not address the teachings of Basta and Smith. Applicant's arguments regarding Basta individually are unconvincing because they do not address the teachings of Smith. Applicant's arguments regarding Smith individually are unconvincing because they do not address the teachings of Basta. The combination of references has been discussed in depth regarding claim 1, above.

Claim 5

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Applicant's arguments regarding Warnes individually are unconvincing because they do not address the teachings of Basta and Smith. Applicant's arguments that Basta teaches zirconium and hafnium halides, but not fluorides, have been addressed in depth regarding claim 1, above.

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Claim 6

Applicant argues that Warnes teaches forming its precursor by flowing HCl over solid aluminum, and that the statement of rejection states that "it would have been obvious... to have provided the metal halide by physical evaporation instead of by reaction of metal with HCl..." Applicant argues that the formation of the rejection can't have it both ways to eliminate the metal to form the rejection of claim 1 and bring it back to form the rejection of claim 6. The argument is unconvincing because it incorrectly posits that it is necessary to eliminate the metal to meet claim 1. The argument is also unconvincing because it implies that the obviousness of one method precludes another equivalent method from also being obvious. Such is not the case. The disclosure of suspenders to keep one's pants up would not render the use of a belt for the same purpose nonobvious. The rejection of claim 6 is based on the long settled premise that the combination of equivalents (e.g., suspenders and a belt) has long been held to be a *prima facie* case of obviousness. See MPEP 2144.06. That is, it would have been obvious to one of ordinary skill in the art at the time the invention was made been obvious to have provided the aluminum halide precursors of Warnes by both the method of Warnes (and Smith) of flowing acid halide over solid aluminum and the method of Smith of evaporation of solid metal halide because Smith demonstrates that they are equivalent methods of producing such precursors. Therefore, Applicant's arguments that the two methods of producing the precursor would be redundant is evidence of obviousness rather than nonobviousness.

Applicant argues that using both methods would not work technically because Basta '963 teaches that its reaction of aluminum and HF occurs at 90 °C, which is below the boiling point of solid aluminum trifluoride. The argument is unconvincing because it incorrectly assumes that each of the solids must be present in the same source at the same temperature, but Warnes '733 teaches that the precursors may be generated from separate sources at separate temperatures (col. 6, lines 12-27). The claims do not require that the "coating source" is an integral mass in a single location, but is open to the possibility that each solid is present in a separate location. The argument is further unconvincing because, even if the claims required a single integral mass, chemicals are more reactive rather than less reactive at higher temperatures. Therefore, one of ordinary skill in the art would have assumed that the reaction of aluminum and HF would have

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taken place at the sublimation/evaporation temperature of aluminum trifluoride. Applicant has provided no evidence to the contrary.

Claim 7

Applicant's arguments regarding claim 7 are unconvincing for analogous reasons to those given above regarding claim 6.

Claim 8

Applicant's argument that none of the references has any teaching of a solid (hafnium or zirconium) (fluoride or iodide) is unconvincing because it does not address the combination of references, as discussed in detail above regarding claim 1.

Claim 9

Applicant's argument that none of the references has any teaching of a solid (hafnium or zirconium) (fluoride or iodide) is unconvincing because it does not address the combination of references, as discussed in detail above regarding claim 1. Applicant argues that according to the recitation of claim 1, the fluoride or iodide is a solid. This statement is incomplete. The claims require that a gaseous fluoride or iodide also be produced. Claim 9 requires only that the fluoride or iodide be applied directly to the article surface; it does not require that the solid fluoride or iodide be so applied. (Note that in the amendment filed 1/27/2003, claim 8 was amended to specifically require that the fluoride or iodide referred to was a solid; no such amendment has been made to claim 9, and therefore it is open to the possibility that it is the gaseous fluoride or iodide that is applied directly to the article surface.) Warnes '733 teach that the gaseous precursors directly contact the surface (col. 6, lines 34-37).

Claim 10

Applicant's argument that none of the references has any teaching of a solid zirconium fluoride or iodide is unconvincing because it does not address the combination of references, as discussed in detail above regarding claim 1.

Claim 11

Applicant's argument that none of the references has any teaching of a solid hafnium fluoride or iodide is unconvincing because it does not address the combination of references, as discussed in detail above regarding claim 1.

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(Response to p. 9, 3rd full paragraph to p. 11, 1st full paragraph) In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

Issue 2

Claim 3

Applicant notes that Basta '614 teaches the applying of coating to airfoils. Applicant does not challenge this teaching.

Applicant argues that Basta '614 does not remedy the deficiencies of the references used to reject claim 1. The argument is unconvincing for the reasons given above regarding claim 1.

Claims 12-13

Applicant notes that Basta '614 teaches the applying of coating to airfoils. Applicant does not challenge this teaching.

Applicant argues that Basta '614 does not remedy the deficiencies of the references used to reject claim 1. The argument is unconvincing for the reasons given above regarding claim 1.

Claim 14

Applicant's argument that none of the references has any teaching of a solid zirconium tetrafluoride is unconvincing because it does not address the combination of references, as discussed in detail above regarding claim 1.

Claim 15

Applicant's argument that none of the references has any teaching of a solid hafnium tetrafluoride is unconvincing because it does not address the combination of references, as discussed in detail above regarding claim 1.

Claim 16

Applicant's arguments that none of the references has any teaching of a solid aluminum trifluoride or solid zirconium tetrafluoride are unconvincing because they do not address the combination of references, as discussed in detail above regarding claims 1, 4, and 14.

Applicant argues that the discussion of claim 16 from the Office Action (reprinted above in the Grounds of Rejection) is not supported by the teachings of the art. Applicant does not point to any supposed error in the Examiner's reasoning other than to reassert that the references do not teach hafnium fluoride. Applicant's argument that none of the references has any teaching of hafnium fluoride is unconvincing because it does not address the combination of references, as discussed in detail above regarding claim 1.

Claim 17

Applicant repeats the arguments regarding claim 6. Therefore, Applicant's arguments regarding claim 17 are unconvincing for the same reasons given above regarding claim 6.

Claim 18

Applicant repeats the arguments regarding claim 7. Therefore, Applicant's arguments regarding claim 18 are unconvincing for the same reasons given above regarding claims 6-7.

Claim 19

Applicant repeats the arguments regarding claim 8. Therefore, Applicant's arguments regarding claim 19 are unconvincing for the same reasons given above regarding claim 8.

Claim 20

Applicant repeats the arguments regarding claim 9. Therefore, Applicant's arguments regarding claim 19 are unconvincing for the same reasons given above regarding claim 8.

(Response to p. 15, 2nd full paragraph) In response to applicant's argument that the examiner has combined an excessive number of references, reliance on a large number of references in a rejection does not, without more, weigh against the obviousness of the claimed invention. See *In re Gorman*, 933 F.2d 982, 18 USPQ2d 1885 (Fed. Cir. 1991). Applicant has not challenged the teaching of the fourth reference (Basta '614) to apply aluminide coating to airfoils.

Issue 3

Claims 1, 3, 5, 6, 9, and 11

Applicant argues that Chang does not teach the use of aluminum halide. The argument is unconvincing because it does not address the teachings of Speirs. Applicant argues that Chang does not teach a carrier gas. The argument is unconvincing because Chang '642 teaches an atmosphere of hydrogen, as correctly noted by Applicant in the After Final response filed

8/25/2003, p. 13. Therefore, Chang '642 teaches a carrier gas. The argument is further unconvincing in view of the teachings of Bornstein '023 other suitable atmospheres (and thus, carrier gases) for aluminum pack diffusion processes (col. 1, lines 39-46).

Applicant argues that Speirs teaches the use of aluminum chloride and ammonium chloride (not fluoride), and that therefore aluminum chloride and ammonium fluoride are not equivalent. The argument is unconvincing. Speirs teaches that a mixture of aluminum chloride and ammonium chloride (or fluoride, Applicant's contention that Speirs does not teach ammonium fluoride is incorrect. see col. 2, lines 47-50) is suitable as an energizer in aluminum pack diffusion processes (col. 3, lines 47-63). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. Applicant's assertion that Speirs teaches that the energizer comprises both aluminum chloride and an ammonium halide is noted. However, the claim language regarding the coating source uses the open language "comprising" and therefore does not exclude the presence of an ammonium halide.

Claim 7

Applicant argues that there is no teaching to use elemental hafnium with hafnium tetrachloride. The argument is unconvincing because Chang teaches that the source of hafnium may be solid Hf powder or HfF_4 (col. 4, lines 33-37), and because it is well settled that "[i]t is *prima facie* obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition used for the very same purpose. . . [T]he idea of combining them flows logically from their having been individually taught in the prior art." *In re Kerkhoven*, 626 F.2d 846, 850, 205 USPQ 1069, 1072 (CCPA 1980).

Claim 12, 15, 17, and 19

Applicant repeats the arguments regarding claim 1. Therefore, Applicant's arguments regarding claim 12 are unconvincing for the same reasons given above regarding claim 1.

Claim 18

Applicant repeats the arguments regarding claim 7. Therefore, Applicant's arguments regarding claim 18 are unconvincing for the same reasons given above regarding claim 7.

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For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,



Michael Cleveland
Patent Examiner
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Conferees


GENERAL ELECTRIC COMPANY
ANDREW C HESS
GE AIRCRAFT ENGINES
ONE NEUMANN WAY M/D H17
CINCINNATI, OH 45215-6301



SHRIVE P. BECK
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700



TIMOTHY MEEKS
PRIMARY EXAMINER
Conferee



Glenn Caldarola
Supervisory Patent Examiner
Technology Center 1700
Conferee